

THE SHORT-TERM ECONOMIC CONSEQUENCES OF THE
MOUNT ST. HELENS VOLCANIC ERUPTIONS
IN MAY AND JUNE, 1980

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EXECUTIVE SUMMARY

Total short-term losses to the economy of Washington State from the Mount St. Helens eruptions of May and June are estimated at \$860 million before reimbursement by federal disaster relief programs. Not counting federal agencies' costs and property losses, the estimated total economic impact is slightly less than \$440 million.

The largest losses occurred in forest damage--almost \$450 million, and in clean-up costs--\$274 million. About \$85 million in property was destroyed or damaged. Agricultural losses, primarily from hay destruction, may exceed \$39 million.

The vast majority of losses occurred in the immediate vicinity of the volcano. This includes all timber losses, over two-thirds of all clean-up costs and well over one-half of property losses. Grant and Adams Counties also sustained large losses: almost all agricultural losses and nearly 10 percent of total clean-up costs. Very little damage or extraordinary costs accrued in areas not directly affected by volcanic debris.

Federal relief was provided for recovery from the short-term effects of the eruptions in the amount of \$951 million. Available records indicate that by October 13th, only \$158 million had actually been disbursed for recovery needs.

Significant losses due exclusively to the eruptions were not evident in tourism, most manufacturing industries, or utilities. Although substantial losses were not found in some sectors, e.g., wheat production, a few individuals were very severely harmed. Economic losses do not necessarily measure hardship and data on many peoples' costs and losses do not appear in available aggregate statistics.

These figures are not final estimates; subsequent events, primarily weather, will affect loss for years to come.

INTRODUCTION

On May 18, 1980, Mount St. Helens, historically the most active volcano in the Cascade Range, 40 miles north of Portland and 90 miles south of Seattle, erupted with a force of an atomic bomb. Approximately 1.5 cubic miles of material was ejected from the cone in clouds of hot gases, rock, steam and ash. Pyroclastic flows destroyed virtually all life in a 150 sq. mi. area to the north of the peak and created a "zone of devastation" extending outward about 5 miles. Mudflows covered thousands of acres of forest land and sped down the North Fork and South Fork of the Toutle River. Within 24 hours the peak's 9,600 ft. elevation was reduced by 1,200 feet. Seismic activity and ejection of ash and gases continued for several days. The eruption probably killed at least 61 persons.

The mudflows are estimated to have left nearly 2.5 billion cubic yards of mud, ash, and debris in the Toutle River Valley, 40 million cubic yards in the Cowlitz River and 16 million yards in the Columbia River. The rate of mudflow in the South Fork of the Toutle River reached 150,000 cubic feet per second--four times greater than the historical record of 37,600 feet in 1910. The bottom of the Cowlitz River was raised 15 to 20 feet, and the depth of the navigation channel in the Columbia River was reduced by two-thirds from its normal 45 feet.

The ash cloud climbed rapidly to an altitude of 50,000 feet and, moving northeast with the prevailing winds, deposited ash in varying depths over much of Eastern Washington. Ash was deposited as far away as Pullman and Western Idaho. Deposits were particularly deep (2"-3") in an area

surrounding Moses Lake and Ritzville in Grant and Adams Counties.

Subsequent eruptions on May 25 and June 12 were not nearly as destructive. Ash deposits were considerably less extensive and fell in other areas. Southwestern Washington was most affected by the May 25th eruption with upwards of 1/2-inch deposits, and trace amounts were found throughout portions of the Olympic Peninsula. On June 12, nearly 1/8-inch of ash covered the Portland vicinity. Subsequent eruptions during the summer have had virtually no effect on areas outside the immediate vicinity of the mountain.

The following discussion is intended to analyze the effects of the eruptions of Mount St. Helens on the state's economy. Several estimates of the total losses or damage to the economy by the geological events have already been made. Additional estimates will be forthcoming as more data become available. Thus, the following estimates are not definitive. Rather, they are reasonable but incomplete estimates based upon the most current information. This, we feel, will allow the reader to understand the economic nature of the events.

The report is organized into three sections. The first section summarizes more specific findings presented later in the report. It is intended to enumerate economic effects in general terms. The second section briefly outlines how the analysis was performed and explains the difficulty of quantifying damage. Finally, the economic consequences of the volcanic eruptions on eight sectors are discussed individually.

CHAPTER I

OVERVIEW OF FINDINGS

This overview of findings is organized as follows:

- . General Economic Consequences

- Government
- Transportation

- . Mount St. Helens Vicinity

- Natural Resources
- Capital
- Tourism
- Income and Employment

- . Ashfall Affected Areas

- Commerce
- Agriculture
- Tourism
- Income and Employment

- . Unaffected Areas

- Tourism
- Investment Climate

In the method used here to assess the economic consequences of the Mount St. Helens eruptions, the impacts to capital and income flows were categorized by geographical location and economic sector. The total damage to capital and the disruption of income flows over all geographic locations and economic sectors was less than \$1 billion. While the consequences of the eruption were relatively small compared to the size of the Washington economy--the overall economic effect was less than the Boeing downturn of a decade ago--the impacts were unevenly distributed across geographic locations and economic sectors.

TABLE I
SUMMARY OF LOSSES AND COSTS
(in \$ Millions)

<u>Sector</u>	<u>Losses</u>	
CLEAN-UP	<u>274.2</u>	
Local (includes ports)		50.5
State		5.0
Federal		209.0
Private		9.7
AGRICULTURE	<u>39.1</u>	
Hay		29.4
Dairy		5.6
Beef - Calf		2.2
Feeder		0.3
Bees		1.6
INCOME	<u>8.9</u>	
Wages & Salary		3.6
Business Revenue		5.3
TRANSPORT LOSSES	<u>2.1</u>	
Ports		1.4
Airports		0.1
PROPERTY (including roads & bridges)	<u>85.3</u>	
Private		39.2
State		2.5
Federal		43.6
FORESTRY	<u>449.9</u>	
Timber-Private		218.1
Timber-State		63.7
Timber-Federal		168.0
TOTAL	<u>859.4</u>	

Table I summarizes economic losses of the eruptions for the state of Washington by economic sector.

Total losses in the state of Washington are estimated at nearly \$860 million. Natural resources, particularly timber, suffered over half of the loss. The next largest loss was in clean-up and post-event repairs of infrastructure; nearly 80 percent of those costs were incurred by federal agencies, notably the Corps of Engineers. These expenses were not, of course, strictly borne by the citizens of Washington State nor do they serve only this state's commerce. Benefits from projects to dredge the Columbia River and to control flooding in the Cowlitz-Toutle watershed will also accrue to residents of Oregon and Idaho as users of the Columbia River navigation system.

General Economic Consequences

Government

One of the hardest hit sectors, particularly in relative terms, was county and municipal government. Many local governments are in financial difficulty because of the eruptions. The degree of financial strain was determined by several factors: proximity to the blast area; depth of ashfall; flexibility of financial resources; and expertise in intergovernmental cooperation. The financial burden to local governments is exacerbated by two major factors. First, the recession and inflation threaten to reduce tax revenues. The second factor is the length of time required for reimbursement of federal funds.

Counties outside the immediate vicinity of Mount St. Helens and the areas of ashfall incurred little or no additional costs. Increases in cost to governmental units near the mountain or lying in ashfall areas can be placed into three basic categories: 1) emergency services; 2) destruction or damage to property; and 3) ash cleanup. To date, the Mount St. Helens related costs to local government have exceeded \$50 million.

A few counties sustained particularly large proportional and per capita clean-up costs. Damage and clean-up costs were exceptionally high in Cowlitz County where public clean-up costs alone exceeded \$30 million and approached \$400 per capita. Adams County and Whitman County also accrued relatively high clean-up costs; \$110 per capita and \$84 per capita respectively. Spokane County was second most severely affected in absolute terms (\$6.7 million), but its large population base held per capita expenses to about \$20.

These figures do not include private sector, state and federal expenses. If they did, costs assigned to Cowlitz County would be very much higher; over \$200 million.

Transportation

While some severe dislocations occurred in ground, air, and water transportation systems, these systems proved to be quite resilient. Alternative transportation modes were effective and reasonably efficient. The major costs thus far in the transportation sector were Corps of Engineer expenditures for dredging of the Columbia River, this amounting to \$45 million.

Transportation in the immediate vicinity of the mountain came to a complete stop. Roads, bridges, and the only major highway in the "blast area" were destroyed, bringing ground traffic to a halt. Traffic is beginning to move in the area and roads are being repaired as timber salvage operations take place. Air traffic, mainly small aircraft, was disrupted after each major eruption.

Transportation was temporarily hampered in areas receiving ashfall. The disruption of ground traffic was related to depth of ashfall. In some areas visibility was so reduced and road surface conditions so hazardous that ground transportation was virtually impossible for all but emergency purposes. Several major highways were closed for a few days. In all but the areas receiving large amounts of ash, traffic returned to normal in three or four days. Air traffic was disrupted in Eastern Washington for approximately one week after the May 18th eruption.

Water traffic on the Columbia River was stopped for approximately one week due to silting of the channel (this may continue to be a problem). The revenue losses to Washington ports along the Columbia River amounted to about \$1.4 million.¹ Water traffic was diverted from the Columbia River ports to other ports in Washington such as Seattle and Tacoma. The Port of Longview in Cowlitz County was closed for a week due to the silting of the Columbia River channel.

Mount St. Helens Vicinity

A loss of \$860 million gives the appearance of a vast amount of devastation. For the area in and around Mount St. Helens where most damage occurred, the losses are substantial. Relative to the state economy as a whole, however, or even to the Southwest Washington region alone, the amount of property damage and capital losses are a small portion of productive capacity. Downed timber, for example, with estimated losses in excess of \$450 million, represents less than one percent of the available timber land in the state. Fortunately, the area in the immediate vicinity of the mountain contained relatively little capital. The fact that few people and little economic activity are located near Mount St. Helens made the event disastrous for the local economy, but not for the state as a whole.

¹Interviews with managers of the Ports of Longview, Vancouver, and Kalama.

Natural Resources

The greatest dollar losses occurred in the immediate vicinity of Mount St. Helens. Timber was the major industry in the "blast area". Estimates of losses for state, federal, and private timber holdings in the area approach \$450 million. Almost half of this loss was on private lands.

Forestry operations in the vicinity of the volcano may be affected for many years by ash residue. Costs for felling and sawing have already increased. Dust will be a continuing problem with possible negative effects on employee productivity and marginal firms. The effect on timber is not expected to cause substantial deviation from the historical employment patterns because normal harvest rates will not be affected by the ash. Forestry employment may increase to compensate for reduced productivity. Mill employment is not likely to be affected, because other timber can be economically acquired within a radius of one hundred miles.

Of all wild and hatchery fish, over 10 million juvenile and a projected adult catch of over 310,000, were lost. This represents approximately a four to five percent decrease in the salmon population for the state of Washington. Economic repercussions of the fish kill will not accrue for about three to four years and can be greatly mitigated by good fisheries management.

Capital

The estimate of damage to capital in the vicinity of the blast area is approximately \$85 million. This includes destruction of roads, bridges, and equipment. Real property loss in Cowlitz County is to exceed \$20 million.

Several other sources of economic loss and recovery costs may become significant over time. In the immediate vicinity of Mount St. Helens, for example, delayed repercussions of the eruptions may cause damage equal to or greater than the initial effects.

Flooding in the Toutle-Cowlitz watershed, for example, may result in greater than normal flood loss of buildings and other physical assets. Investments have been made to protect against that likelihood, but these measures may not be totally effective. Also, degradation of water supply and treatment from volcano related damage and pollution seem to be worsening. Water facilities in the area may soon require adaptation or replacement.

Tourism

Tourism in the Mount St. Helens area is expected to be affected over time. Certain types of recreational activity, e.g., hunting and fishing, may be dislocated for many years, while sightseeing will probably grow faster than previously expected. This may change the structure and size of tourism dependent employment in the area. Also, construction may be undertaken to exploit the new tourism opportunities.

Income and Employment

Measurable increases in unemployment occurred in Cowlitz, Lewis, and Clark Counties; all located near Mount St. Helens. In each county, the unemployment impacts dissipated by the third week of June. In a single known exception equipment losses have temporarily displaced 100 employees. Unemployment rates in these counties are estimated to have been 15 to 35 percent higher as a result of the eruptions at

various times during the five-week period following the May 18 eruption. The wage and salary losses in the three countries are estimated to be \$2.74 million.²

Ashfall Affected Areas

Commerce

The effects of the ashfall are somewhat analogous to those of a major snowstorm. As with snowstorms, the costs and inconveniences can be correlated with depth of ashfall. Firms in areas which received ashfall in trace amounts experienced little inconvenience or increase in costs. Firms in areas receiving two to three inches experienced the greatest inconveniences and cost increases.

Relatively little capital was destroyed or damaged by ashfall preventing the eruptions from being economically devastating to the private sector. In areas that received large amounts of ash, transportation and movement slowed or came to a complete halt. Businesses closed, deliveries were delayed, production stopped, and sales were not made. Within a few days transportation was restored to normal or nearly normal levels. As transportation was restored businesses reopened, and deliveries, production and sales resumed. The major costs incurred by businesses were production and sales delays and clean-up costs. A few firms experienced increases in maintenance costs due to the abrasive nature of the ash.

²Hunt, Carl E., "Income and Employment Impacts of the May-June, 1980 Eruptions of Mount St. Helens," Department of Commerce and Economic Development. (working paper)

Agriculture

Fortunately, original predictions of massive losses in agricultural output did not materialize. Agricultural output for the state may approach record levels this year. Even with record yields, some losses can be attributed to the eruptions. The losses are primarily distributed in geographic areas receiving one to three inches of ash and impacted only a small number of crops.

Two major factors mitigated the potential losses in agriculture. One was the adaptability of agricultural practices to changing situations. The second was the unseasonably heavy rains occurring early in the summer. Total agricultural losses are estimated to be under \$40 million, with almost \$30 million of the loss coming from the first cutting of hay. Grant, Adams, and Yakima Counties, areas which received large amounts of ash accumulation, were also areas where the most severe agricultural damage occurred.

In Eastern Washington, agriculture may be affected in several ways. Soil productivity problems may occur where ash accumulation was significant. Ash may affect soil temperature and cause germination, pest and disease problems. The devastating affect on bees may result in substantial losses to apple producers. If lower levels of pollination result, incomes to producers of fresh market apples would be reduced. Sustained exposure of farm machinery to ash may increase operating costs significantly over the next few years, depending upon the level of wear and corrosion caused by the ash.

Tourism

Disruption of tourism in areas receiving ashfall in Washington State was short-lived. The national recession, gasoline prices, and weather were more significant factors than ashfall in causing a slump in the tourism industry. Decline or zero growth of tourism reflects a changing pattern of recreational travel, also apparent nationally, toward reduced travel to outlying areas and shorter trips generally.

Income and Employment

The employment and earnings repercussions of the eruptions were also unevenly distributed and generally short-lived in areas receiving ashfall. Measurable increases in unemployment occurred in Adams and Grant Counties; both counties receiving large amounts of ashfall. In each county the unemployment impacts dissipated by the second week in June. Unemployment rates in these counties are estimated to have been 15 to 35 percent higher as a result of the eruptions at various times during the four weeks following the May 18th eruption. Wage and salary losses in Adams and Grant Counties are estimated to be \$847 thousand.³

Unaffected Areas

Many areas in the state received no ashfall or only slight traces. The Puget Sound region, the major industrial and population center in the state, received virtually no ashfall. In this and other regions which received a trace of ashfall, life and economic activity continued in their normal patterns. The major costs to firms in the unaffected regions related to delays in shipments to and from, or through areas receiving heavier amounts of ashfall. There

³Ibid.

were no adverse effects in employment or agriculture in areas receiving little or no ashfall. Revenues and expenditures for local governments were also not affected in these areas. Unaffected areas comprise a large part of the state including the most populated and industrialized regions in the state.

Tourism

Tourism was disrupted in areas receiving no ashfall for a short period of time. Immediately after the May 18th eruption there was an impression that the entire state was blanketed with several inches of ashfall. This perception was dispelled over time by accurate reporting and promotional activity by the travel industry and the state of Washington. With the help of these activities, tourism returned to normal levels shortly after the Memorial Day weekend.

Again, the national recession, gasoline prices, and weather were more significant factors than ashfall in causing a slump in the tourism industry. Decline or zero growth of tourism reflects a changing pattern of recreational travel. This trend is also reflected nationally as travel to outlying areas is reduced and in the tendency towards taking short trips.

Investment Climate

On a statewide level, there have been indications that the investment climate of the state has been significantly degraded by a perceived threat to communities and firms from further volcanic activity. Initial fears about this problem, manifested as reduced investment in plant and equipment and higher interest rates on municipal bond

offerings, have subsided somewhat, but subsequent events, e.g., flooding, could heighten the perceived risk in specific locales.

Beyond the potential future losses attributable to the May 18 eruption, there is the possibility that future eruptions may have greater and/or different destructive impacts. The impact of subsequent eruptions will depend upon when they occur, weather conditions during the event, and degree of preparation. Damage from such an event is not predictable, but it could certainly be large regardless of the level of preparedness.

CHAPTER II

METHODOLOGICAL NOTES

This investigation focused on the short-term economic impacts of the eruptions, the measurement of which presents numerous problems. For instance, the measurement of economic loss does not necessarily include hardship. Homeowners or businessmen who personally spent hours cleaning off the rooftops of their houses or businesses, did not suffer a measured economic loss, since no transaction was recorded to document their activity. We must emphasize that this anomaly will cause some very large and sometimes debilitating losses to individuals to remain uncounted. If they had paid other persons to perform the same services, however, the costs would have been counted.

Another conceptual problem was the circular nature of economic activity. For example, if you required someone's services to clean your roof, your loss was their gain. A redistribution of income occurred from those damaged to those whose services or products were required for rebuilding or restoration. However, the available economic data are not sensitive to all redistributions of income, but rather, give only gross totals.

Economic losses and gains can be placed into two broad categories: flow or income changes, and stock or capital changes. Each is measured differently and has differing effects on the economy. The difficulty of aggregation in income measurement has already been mentioned. Another problem is that many different factors impinge simultaneously upon an economic system. Isolating the effects of any one factor is difficult. As a case in point, a national

recession and rapidly rising interest rates were occurring with the eruptions. All of these factors had income and employment effects in this state--but in uncertain proportions.

Measuring stock or capital losses also presents problems. When capital is destroyed, numerous decisions must be made in the valuation of capital and the measurement of its loss. Capital can be valued by numerous methods including its book value, replacement value, or its original price. Another consideration was how, if at all, the income stream from capital should be valued.

Some categories of losses have not been considered in this estimate of the economic impact of the Mount St. Helens eruptions. This is because several factors affect their final dollar value in ways which cannot be easily predicted or understood. Possibilities for substitution of goods, changes in management practices, and interaction with non-volcanic factors combine to make evaluation unclear. Losses which could not be solely attributed to volcano impact were excluded from the analysis. Some areas where the relative effect was possibly negative, but where the absolute results were distinctly positive (e.g., apples), were excluded. Other losses anticipated to occur later, but with unpredictable timing and magnitude were also omitted. Two examples will illustrate evaluation problems under complex conditions.

In agriculture, a highly unusual weather pattern in the late spring combined with ash to affect yields of several crops in positive and negative ways. While a good wheat yield was anticipated this year, substantial losses were expected from grasshoppers. The pest population was virtually destroyed by ash, and the percolation characteristics of the soil altered. By holding water near the surface, ash fostered

certain diseases which caused some reduction in net yield. On balance, the higher water level also contributed to extraordinary growth. With normal rainfall, growth would have been generally lower though pestilence would have been insignificant; ash would have had a neutral or slightly positive effect. Extraordinary rainfall, however, led to a record crop, disease notwithstanding, which would probably not have been as great without the ash.

Also, it is impossible at this time to predict the net economic effect of ash on the value of land parcels and productivity in agriculture into the future. Some losses and gains are bound to appear, but net effect and distribution in space and over time are unknown.

Similar problems exist in trying to estimate the value of lost wild game and non-game populations in the mountain's vicinity. The net loss to the state will depend upon the state's game management practices, the rate of recovery of natural ecosystems, the opportunities facing businesses which depend upon these resources, and recreational visitors' adaptability to the new conditions in that area. Economic losses resulting from these types of impacts hopefully can be minimized by policy changes. To the extent that they are not, part of the costs and losses must be viewed as administratively incurred and not a direct, indisputable result of the eruption.

The balance of this report is organized into brief descriptions of damage and costs in eight sectors of the state economy. Two resource based industries are covered first. They are followed by two sectors--tourism and utilities--in which massive losses were expected but not realized. Transportation and property losses (including capital base losses) are covered next, followed by discussions of government and manufacturing sector effects.

CHAPTER III

A. FORESTRY⁴

Timber was the economic resource most severely affected by the May 18 eruption. Over an area of 146,658 acres (229.2 sq. mi.), a net total of 1.8 billion board feet of old growth, second growth and immature (saplings, etc.) timber was destroyed. However, not all of this timber should be considered an economic loss in the strictest sense. Much of the old growth and some second growth timber on U.S. Forest Service land was being withheld from commercial harvesting under the RARE II (wilderness area) planning process. Considering only the net value of timber lands which were being managed for harvest, the total economic loss is approximately \$450 million. The information on noncommercial U.S. Forest Service timber included in Table II is for purposes of comparison only.

Table II

	Summary of Impacts on Forested Land				Non-	Total
	-----Commercial-----				Comm.	
	<u>Private</u>	<u>DNR</u>	<u>USFS</u>	<u>Total</u>	<u>USFS</u>	
Acreage	70,720	12,014	26,564	124,076	15,178	146,708
Volume (mil. bd. ft.)	721.7	134.9	302.3	1158.9	671.6	1,803.5
Value (\$million)	218.2	63.7	168.0	449.8	257.0	706.8

⁴This section is an interpretation and analysis of timber loss estimates prepared by the Operations Research Division of the Washington State Department of Natural Resources using data generated by the United States Forest Service (USFS).

Most of the affected acreage was private property. Volume losses did not accrue proportionately with acreage because a substantially larger portion of the private and state lands, as opposed to federal lands, had been cut and replanted. Private owners sustained the greatest absolute loss of commercial timber at \$218 million; fairly evenly split between old and second growth stands.

The U.S. Forest Service lost about \$168 million in ground cover (all types of mature and immature timber) on lands which were not being withheld from harvest because of RARE II (wilderness area) designations. In addition, there were another \$257 million worth of timber on lands currently being withheld from harvest by wilderness area considerations. If all destroyed U.S.F.S. timber were considered commercial, it would have been the greatest loser at \$425 million. If salvage is undertaken in areas now under wilderness consideration, timber from these lands may be viewed as a net addition to the resource.

The value of destroyed state of Washington timber approaches \$64 million, mostly in old growth and immature reproduction stands. These lands are managed by the Department of Natural Resources (DNR).

Of the estimated \$1.8 billion board feet of ground cover (all ages) that was destroyed by the May 18 blast, it appears that 55 percent of the volume loss was due to mudflows, 36 percent to blow down, 3 percent to water submersion and 6 percent was left dead but standing. The value of the loss was very high because salvage from mudflow damage is considered impossible and most of the mudflow damaged volume was in old growth timber - the highest valued wood.

Table III

Area Impact of
the May 18 Eruption
on Forestry

<u>Acreage In</u>	<u>Owner</u>			<u>Total</u>
	<u>DNR</u>	<u>USFS</u>	<u>Private</u>	
Old Growth	3,030	27,898	5,581	36,509
Second Growth	718	7,725	28,163	36,606
Other Wooded	8,266	6,119	36,526	50,911
Acres Forest	12,014	41,742	70,270	124,026
Non-Forest	246	19,833	2,553	22,632
Total Acres	12,260	61,575	72,823	146,658

Source: Department of Natural Resources

The blast from the first major eruption on May 18th affected about 124,076 acres of forested land, 59 percent of which was in non-merchantable sized stands. Old growth and second growth stands each represented about 29.5 percent of the affected forest acreage. Almost 50 percent of the affected acreage was privately owned and 42 percent was National Forest.

B. AGRICULTURE⁵

This section addresses agricultural losses sustained in Washington State as a direct result of the Mount St. Helens eruptions. No attempt is made to isolate the net effects of ash when interaction with weather or farming practices seem to be contributing factors. Similarly, the beneficial effects of ash were not isolated because they seem to vary depending upon a number of factors and in ways which are not yet understood by scientists.

The effect of ash upon individual agriculture producers varied widely. There are many cases where individual producers of a given crop, e.g., wheat, suffered extremely high losses while the sector as a whole seemed to be largely unperturbed by ash. The variation in impact among individual places and producers is recognized. This report does not mean to suggest that zero losses have been sustained at disaggregated levels of analysis.

Initially, there were expectations that the eruptions would cause extraordinary damage upon all agricultural sectors in areas affected by significant quantities of ash. Some speculations were that ash would destroy crops by physical effects such as crushing or smothering. Also, there were fears that ash would immediately reduce productivity by altering soil chemistry. These expectations did not materialize. Nonetheless, there is potential for some loss of productivity over the long run for certain parcels of land.

⁵The findings of this section are based upon data published in news media and by consultation with several individuals in the Washington State Cooperative Extension Service and in the private sector.

Table IV summarizes identifiable net losses for several agricultural sectors. All of the figures are based upon a worst case scenario of market conditions. No consideration is given to changes in operating costs except where noted. The largest component of the estimated \$39 million loss occurred in the hay sector. Although losses to grain and fruits are listed as zero, this probably underestimates the full losses. The loss to hay, on the other hand, may be over-estimated. Thus, the total loss figure is probably a better estimate than its component figures.

Table IV
Estimated Losses in Agriculture

Hay	\$29,400,000
Livestock	
Dairy Product	240,000
Dairy Costs	5,400,000
Beef Loss	2,496,000
Fruit	-0- ⁶
Grains	-0- ⁶
Bees	1,560,000
TOTAL	<u>\$39,056,000</u>

Two factors seem to have contributed greatly to reducing the ultimate level of loss to agriculture. The first and probably most important factor has been the adaptability of agricultural practices. After only a few weeks--sometimes days--of experience with the ash, farmers were able to adjust their practices to prevent the kinds of losses which were expected using normal practices. The adjustment was greatly facilitated by the efforts of the Cooperative Extension Service of Washington State University through its publication Ash and Agriculture published regularly during the growing season.

⁶Net loss based on calculation of estimated losses and gains.

The second fortunate circumstance, which was less universal, was the very heavy unseasonal rain which followed the eruption. The rains may have mitigated much damage which might have occurred by washing dust off of many plants and by causing it to compress. After the rain, the ash formed a clay-like seal at the surface which reduced the rate of evaporation and thereby provided more moisture to the roots. This phenomenon seemed particularly beneficial to wheat production and, perhaps, to other grasses. The same rains were very destructive, however, to cherries and to hay in some areas.

The immediate impact of ash on agriculture correlated roughly with the depth of ashfall. Agricultural losses varied among crops because each has a different sensitivity to ash. The most severely affected areas were portions of Grant, Adams, and Yakima Counties; all received very heavy ash accumulations. On balance, ashfall has had one distinctly positive effect; its destruction of grasshoppers reduced pest control expenses and related crop losses this year.

The soil of Eastern Washington is largely comprised of ash deposited by Cascade Range volcanos in antiquity. Chemically, the soil of the area is slightly less acid than that which was deposited by the recent eruptions. This was considered to be a problem at first, but subsequent measurements indicate that the acidity was reduced to tolerable levels by the leaching effects of unseasonal rain immediately following the eruption.

Several physical problems may arise over time. First, loose ash seems to be especially susceptible to erosion by wind and water. This may lead to chronic blockage of irrigation channels and even to accelerated erosion of the pre-existing

top soil. Concern has also been expressed that ash deposits may negatively affect the ability of the soil to absorb or "percolate" water. These difficulties may cause inadequate supplies of water to reach the roots and rotting of stalks (in grasses, especially) due to puddling at the surface. Second, the reflectivity of the soil surface may be changed with the possible result that underheating of the soil will negatively affect germination and the viability of certain important microbial processes. Finally, operators are concerned that maintenance costs of agricultural field machinery will increase. A related problem is damage to irrigation facilities and equipment. Filling and washing out of ditches may be accelerated requiring increased expenditures to maintain them.

Hay

The major producing region for alfalfa hay is the Columbia Basin--one of the areas most heavily hit by ashfall. Approximately 34,600 acres of alfalfa hay were severely affected by heavy ashfall; about 15,660 in Franklin County and 18,940 acres in Grant and Adams Counties. A total of 134,000 acres--one-sixth of the state's hay acreage--are in these counties. About one-third of statewide hay production originates in this area.

The maximum total loss (worst case scenario) is around \$29.4 million; Grant and Adams Counties - \$18.8 million, Franklin County - \$10.6 million. The extra cost of operation was not factored into the cost estimates.

The price of hay in the statewide market was temporarily pushed upward immediately following the eruption. Dairy producers, apparently concerned that adequate quantities of dairy quality hay might not be available from the Basin, bid

up prices on unaffected hay in the region. Hay prices upwards of \$160/ton and averaging \$125/ton were reported for a few weeks after the eruption. Typical prices were about \$20/ton higher than the 1979 range of \$100-110/ton. Before the eruption, 1980 prices had been expected to range between \$110 and \$120/ton at the stack.

In the high side loss estimate, total physical losses are estimated at 89,200 tons - about 10.2 percent of the expected annual yield. In addition, some feed was imported in response to the eruption, possibly up to 75,000 tons. To provide a perspective, winter-kill reduced hay output by about 20 percent in the '78-'79 season. In addition, another 20-25 percent of value in first-cut hay was lost to untimely rains this year in some areas largely unaffected by ash.

Dairy and Beef

Overall, the dairy and beef industries were affected by the eruption only indirectly--primarily through their reliance upon the hay producers of Eastern Washington. No cattle were killed or injured as a direct consequence of the eruption outside of the immediate vicinity of the volcano.

Dairy producers accrued some economic losses and have made some adjustments to their normal practices to prevent further losses. One effect of the eruption on the dairy industry was that between 115,000 to 230,000 gallons of milk were discarded because the eruption temporarily blocked collection from farms and storage capacity was exceeded. At wholesale prices for milk, this loss totals between \$120,000 and \$240,000.

Dairy producers adjusted to the decrease in hay quality by several means. Almost totally rejecting the first-cut hay from the Columbia Basin--usually 55-60 percent of their total annual hay purchases, they bought second-cut hay from the Basin and imported hay from western Montana, Idaho and Oregon; two non-traditional sources of dairy hay. The net cost to dairy producers resulting from increased prices and transportation premiums for imported hay was about \$45/ton. Total increased cost estimates to date range from only \$675,000 for 15,000 tons of additional imports to \$3,375,000 for 75,000 tons. Depending upon the weather this winter and the actions of dairy farmers, a grand total of 120,000 tons of hay may need to be imported. Assuming in the worst case that all of this hay is actually imported, the net effect would approach \$5,400,000. At most, this is about 1.6 percent of the gross income to dairy farms in 1979.

Beef producers did not suffer substantial cost increases from the eruption, and virtually all of their losses will result from a reduced rate of weight gain in feedlot herds and by a reduced weight of calves delivered to the market. For the entire Eastern Washington beef production industry, estimated losses may total \$2.5 million.

The only significant feedlot populations exposed to the effects of ash were in the Columbia Basin. About 31,500 head of feeder cattle were in areas affected by ashfall of over one-half inch. Total feedlot losses may approach \$289,500 at a rate of \$9.19 per head.⁷

⁷This figure is derived from data and estimates on expected rates of weight loss, beef prices provided by Dr. Bill McReynolds, Cooperative Extension Service, Washington State University.

The cow-calf sector of the industry may have been affected by a reduced milk output of cows with calves if the cows were put off their feed by a change of diet necessitated by the ash. This could result in calves weighing about 30 pounds less than expected with a loss of \$24.00 per head.⁸ The loss to cow-calf operations could approach \$2,206,500.

Another factor which may affect the industry is ash related tooth wear. This could reduce the life expectancy of cattle and thus, their final net value.

Fruits

The tree fruit industry does not appear to have been significantly affected by volcanic ash. Apple growers were able to prevent most types of damage to their orchards by quickly shaking ash out of the trees. Some spotting of apples may have occurred, but this has not been reported as a significant problem. In fact, 1980 was a record year for apple production. Peaches seem not to have been affected. Pears have also enjoyed a record crop. Apricots also seem to have survived quite well.

Cherries sustained significant losses this year as a result of unseasonal rain and cold. Nonetheless, the cherry crop is down only nine percent from last year's record.

Raspberries seem to have suffered from ashfall because of the difficulty in removing ash from the deeper crevices of the berry. The blueberry and strawberry yields are lower this year than last, but effects directly and solely attributable to ash are indeterminable.

⁸Ibid.

Wheat and Other Grain

The wheat crop of 1980 broke records for both quantity and revenue. Although volcanic ash may have caused some physical blockage of young wheat sprouts, unusually heavy spring rains pushed net grain output to very high levels.

Nonetheless, output of some farms in the Ritzville area was virtually destroyed by heavy ashfall. Estimates put the statewide yield at around 150 million bushels - 29 percent higher than 1979 and above the record 1976 harvest of 147 million bushels. Priced at \$4 per bushel, the 1980 value of \$600 million is 30 percent above last year's \$460 million.

Barley yield is expected to be 44 percent higher than 1979. Other grain crops also seem not to have been greatly affected.

Neither peas nor lentils were harmed by the ashfall. The 1980 pea harvest is record breaking. The per acre yield is 2,200 to 2,400 lbs. compared to the previous record 2,000 lbs. and a 10-year average of 1,500 lbs. Prices, however, are down about 20 percent, due in part to a 100 million pound carryover from last year. The lentil crop is running ahead of 1979's sub-average yield. The 1980 yield will be only average or below because of poor weather conditions.

Bees

There are nearly 90,000 bee colonies (hives) in the state; about 60,000 are managed commercially, 30,000 are owned by hobbyists.

Approximately 12,000 commercial colonies in Eastern Washington were severely affected by the ashfalls of May 18 and May 25. Approximately 1,500 colonies were destroyed by suffocation; the balance were damaged temporarily interrupting productive capacity. The total value of the losses approaches \$1.56 million. In relative terms, the bee industry may turn out to be the most severely affected agricultural sector.

C. TOURISM

Revenues to the tourist industry are sensitive to changes in income and fluctuations in the price and availability of gasoline as well as natural events. The current recession and the increasing price of gasoline have changed the pattern of tourism and foreshadowed a decrease in tourism for 1980 with or without a volcanic event. Decreases attributable solely to the volcanic eruptions are difficult to isolate, but at the state level are considered to be small compared to the other, more significant trends.

Overall, the Mount St. Helens eruptions probably had a negligible impact on tourism. The major impacts of the eruptions on tourism were reduced Memorial Day weekend revenues to tourist establishments statewide and total seasonal revenues of tourist establishments in the immediate vicinity of Mount St. Helens. Measuring the impacts of the volcanic eruptions on tourism is especially difficult because sufficient data will not be available until 1981 or later.

State and national park data were analyzed to obtain some generalities of the tourist industry. Park visitations were chosen because they directly measure tourist activity. Park visitations are believed to fluctuate primarily for the same reasons as other tourist activities. Therefore, changes in park visitation was adopted as a proxy measure for change in all tourism.

Analysis of the data from state and national parks support the thesis that the economy, gasoline prices and availability of gasoline have had an adverse impact on the tourist industry. A recent study by the Department of Commerce and Economic Development indicates that there is a high degree of correlation between park attendance in Washington State,

real per capita income, and gasoline prices.⁹ With a decrease in real per capita income from 1979 to 1980 of 1.2 percent in Washington State and an increase in gasoline prices of 41 percent, the study predicts a decrease in park attendance of 18 percent.

A review of visits to national parks across the country by month for the years 1977 to 1979 indicates a similar pattern of visits to these parks in each year. The lowest number of visitations is in January, with the number of visits increasing to a peak in July, followed by a small decrease in August and a sharp decline in September which continues through the rest of the year. While the pattern remains the same, the number of visits in any given month has changed. From 1977 to 1978 visitations increased from 262 million to 283 million and from 1978 to 1979 the number of visitations decreased by 1 million. Most of the decrease came in the peak months of June, July, and August.

Data on Washington State park attendance for 1980 supports the notion that tourism was more affected by other factors than the eruptions. Both March and April park attendance were below 1979 levels, a trend which continued through May and June. The data suggest a pattern of decrease beginning before the eruption and continuing after the eruption. In fact, in comparing 1980 with 1979, the March and April decreases in park attendance were more severe than the May and June decreases.

⁹Hunt, Carl E., "Tourism Impacts of the May-June, 1980 Eruptions of Mount St. Helens," Department of Commerce and Economic Development. (working paper)

Thus, given the national recession and continuing increase in gasoline prices for 1980, decreased tourism in Washington State would have been predicted even without the Mount St. Helens volcanic eruptions. In addition, using park visitation as a proxy for tourism, the generalization can be made that the pattern of tourism appears to be changing fundamentally. People are staying closer to home. Park attendance near populated areas has shown an increase while park attendance in remote rural areas has been decreasing. This is a reversal of historical patterns. This changing pattern of tourism is also causing a redistribution of tourist dollars from the more rural areas to metropolitan areas. Tourist establishments in metropolitan areas are gaining while tourist establishments in rural areas are losing customers, and some are being closed.

This trend can be observed from another angle by comparing the changes in national park attendance between populated states and less populated states for the years 1977 to 1979. The change in park attendance in the more populated states has been increasing over these years. The change in park attendance in the less populated states increased from 1977 to 1978 but then plummeted 14 percent in 1979. It is suspected that the less populated states depend upon tourists from the more populated states. These changing patterns of tourism can be attributed to lower real incomes and higher gasoline prices as well as gasoline availability.

The foregoing analysis allows some inferences to be made on the tourism impacts of the volcanic eruptions. The impacts are likely to have had limited duration and geographic scope. Major decreases in tourism revenues are likely to have been associated primarily with the Memorial Day weekend. After that, tourism revenues are expected to have returned to near expected levels; at or slightly below 1979

levels when corrected for inflation. Testing of these hypotheses must wait until better data becomes available. Tourist establishments in the immediate vicinity of the volcano definitely have been severely harmed, particularly those located inside the red zone. These impacts are likely to continue until the restricted area is reopened to general access.

In the short run, income will be redistributed from the Mount St. Helens area to other areas in the state. For example, people who planned on visiting the Mount St. Helens area are not likely to cancel their plans altogether. They are likely to visit other areas in the state or the Pacific Northwest. The impact will not be felt by the state as a whole, but will be felt in the immediate vicinity.

Projections of a great increase in tourism in the Mount St. Helens area are being made for the long run. These predictions must be kept in perspective. Mount St. Helens is likely to be a bonanza to Cowlitz and adjoining counties. The state as a whole, however, will not likely gain very much. The real benefit to the state will be from out-of-state tourists attracted to Washington State as a result of Mount St. Helens.

Several initiatives to reduce tourism losses were taken soon after the eruptions. The private sector, led by United Airlines, organized a fact-finding tour of the region for travel journalists from all over the U.S. to demonstrate that environmental amenities were not substantially affected. The Pacific Northwest Regional Commission funded a publicity campaign in the media of several major U.S. metropolitan areas explaining the minimal impacts from the eruption on tourist attractions. The Economic Development Administration of the U.S. Department of Commerce funded a

publicity campaign in print and broadcast media to promote tourism within the state by state residents. These programs included both national and statewide toll free telephone information services providing current reports on weather and road conditions throughout the state. These efforts were supplemented by local promotional efforts in many communities such as Spokane and Yakima.

D. UTILITIES¹⁰

Utilities are generally among the hardest hit sectors of the economy when disasters occur due to their vulnerability. Surprisingly, most public and private utilities in this state received relatively little damage as a result of the eruptions--even in areas of heavy ashfall. Three exceptions were the communities of Kelso, Longview, and Castle Rock. Mudflows and debris carried down the Cowlitz River either destroyed or buried water and sewage systems for these communities. Large portions of these facilities may have to be relocated and replaced (see also section on Governments).

In locations which received one to three inches of ashfall, such as Yakima and Moses Lake, blockage of sewer systems and turbidity in water supplies presented temporary problems where filters and clarifiers were damaged. Most water and sewer jurisdictions around the state, however, were unaffected.

Electric utilities in the region were not affected except in the immediate area of the blast and mudflows. Some increased costs occurred in the effort to maintain service and clean insulators. Meter reading schedules were also disrupted. Utility companies estimate the cost associated with the eruptions to be equal to or less than the average electrical storm.

¹⁰ These findings are based upon the September 26, 1980 report: Northwest Economists Evaluate Volcano's Impact. The Northwest Economists is an ad hoc group of 22 economists employed in both the public and private sector in Oregon and Washington who examined the economic effects of Mount St. Helens on an industry-by-industry basis.

Gas utilities were not affected except where the ashfall disrupted meter reading schedules and service calls.

The telephone utilities experienced minimal damage. Maintenance schedules for vehicles and plant equipment were stepped up. As with most disasters, telephone system usage was extremely high and considerably above peak load levels during the week following May 18.

E. TRANSPORTATION¹¹

Transportation in Washington was affected by the eruptions in three ways. In some areas visibility was so reduced and road surface conditions were so hazardous that driving was virtually impossible for all but emergency purposes. Also, there was difficulty due to the effects of ash on machinery - particularly to automobile and truck engines. Finally, the flow of ash and silt into the Columbia River caused a temporary closure of the lower Columbia to sea-going transport traffic. Commercial air traffic was not affected in Western Washington. Air traffic was temporarily interrupted in Eastern Washington and in the immediate vicinity of the mountain. The flexibility of the transportation system prevented bottlenecks from causing shortages of most goods in most places. In cases where substitute means of transport could not be made, the duration of traffic interruption was too brief to cause discernable effects on prices. The most accountable loss in the transportation sector was in dredging the Columbia River navigation channel by the Army Corps of Engineers at a cost of \$45 million.

Table V

Losses in Transportation

Waterway Dredging	\$45,000,000
Water Transport	1,400,000
Air Transport	72,000
Ground Transport	not estimable
Total	<u>\$46,472,000</u>

¹¹These findings are based upon newspaper accounts and reports by the Department of Natural Resources, the State Department of Transportation, FEMA, and personal communications with several officials in local and state agencies.

Highways and Roads

Total traffic statewide in May 1980 was 16.8 percent below May 1979. Part of the decrease, especially in commercial traffic, can be attributed to the general economic slowdown. Some of the decrease, however, is directly attributable to the eruptions. Most disruption of highways occurred in Eastern Washington. After the May 18 eruption Interstate 90 was closed until May 24 and U.S. 12 over White Pass was closed until May 22. Necessary east-west travel was diverted to U.S. 2 over Stevens Pass and, to a lesser extent, through the North Cascades via State Route 20.

Interstate 5 was temporarily closed three times on May 18. Traffic at the Olympic Peninsula was unexpectedly heavy--thought to be people attempting to avoid the ashfall. Intra-urban travel was affected also. A survey of 26 communities found that communities were immobilized for up to 14 days, but half were able to recover within 3 days. Subsequently, travel conditions in high ashfall areas were poor for as long as a month.

Trucking and railroad sectors expect slightly higher maintenance costs for vehicles operating in affected areas. As yet, no major or continuing costs have been imposed on operators other than minimal costs of changing air filters, oil, or operators lubricating more frequently.

Waterways

In the heavily traveled Lower Columbia River, depths were reduced by more than two-thirds to around 14 feet. The channel width was reduced by 50-65 percent to 200 feet. After the grounding of a ship, traffic was limited to those

drawing less than 13 feet. Channel depth was restored to 25 feet within a week and to 35 feet within three weeks. Channel width was restored to 300 feet by late June. Dredging by the Army Corps of Engineers to restore transportation on the Columbia River is estimated to have cost \$45 million. This does not include the possible costs of redredging which may be required due to fall flooding and, possibly, winter run-off in the spring. In some respects this could be considered a net gain to the region since it will create employment and represent an infusion of income from outside the region. Efforts being made to control floods in the Toutle-Cowlitz watershed are also not included. While these efforts are primarily intended to protect communities from flood hazard, the measures, if successful, will reduce the amount of silt reaching the Columbia.

The Port of Portland was blocked for ocean-going traffic for the first week. About 31 ships were stranded in port and the average 6 ships per day of traffic was diverted to ports lower on the Columbia--Longview and Astoria--and to Puget Sound ports--Seattle, Everett, and Tacoma. Misinformation about the river's capacity seemed to persist after it was reopened, causing traffic to be diverted unnecessarily from Longview and Astoria, which were unaffected, as well as from Portland. Blockage of the Lower Columbia required that grain shipments from Eastern Washington and Oregon and Idaho be suspended for almost three weeks. There were no other major eruption related impediments to river-borne shipments in the Upper Columbia.

Total costs and losses to the ports of Washington State are about \$1.4 million, including public relations expenditures to counteract erroneous impressions in the international shipping industry. On balance, due to shipping displaced from Oregon ports, traffic in Washington ports in Puget Sound probably gained.

Because of the immediate action of the Corps of Engineers the loss to ports was minimal. Their quick action also held down costs for water transportation. Even without the action by the Corps, the transportation system is probably flexible enough to adjust to closures and blockages with only minimal cost increases in the aggregate. Some operators and ports will be harmed economically as different routes and modes of transportation are used. Those losses will be gains for other individuals and transportation modes.

Air Traffic

Significant disruption to commercial aviation in Washington State was limited to airports in Eastern Washington. Traffic to and from SeaTac Airport may have been reduced but this may have been compensated, in part, by traffic diverted to SeaTac from Portland. The Spokane and Yakima airports were both effectively closed for one week. Their estimated revenue losses--landing fees and net rental income--were \$47,000 and \$25,000 respectively.

F. PROPERTY LOSS¹²

Public Losses

The largest losses of physical capital were sustained by Federal agencies--\$43.6 million. Almost \$8.2 million will be spent to replace a state operated fish hatchery on the Toutle River and administration buildings in the Gifford Pinchot National Forest. At least another \$35.4 million will be required to replace destroyed roads and bridges. State capital losses, an estimated \$2.5 million, include reconstruction costs of roads, bridges, and buildings on forest lands and replacement of buildings and inventory in fish hatchery operations.

Private Losses

Private capital losses have been substantial--\$39.3 million. Two types of losses occurred: actual destruction of property, and reduction in real property value. Destroyed private capital probably amounted to about \$23 million, including \$8.8 million to Weyerhaeuser equipment.

Property value losses are difficult to estimate. Conclusive judgements can be made only where property has actually disappeared. Total losses of this type amount to about \$16.3 million.

¹²Data for this section were taken from reports by government agencies and interviews with county and state level officials.

Cowlitz County was the only county to sustain a loss of real property. Real estate and buildings with a pre-eruption assessed value of \$15 million were reassessed at zero value due to their burial or erosion by mudflows (losses to timber are discussed in another section of this report). Much more property is subject to damage from potential flooding of the Cowlitz-Toutle watershed this autumn. Some of this property is insured. On a lesser scale, Skamania County reported losses of taxable property of around \$1.3 million.

There has been a reduction in the number of realty transactions in the Cowlitz area, but this is thought to be largely a result of the general economic conditions and not solely due to the eruption. Non-residents seem interested in purchasing properties in the mudflow zone. Current owners, however, seem unwilling to sell at the prices offered. Sixteen property owners, with combined holdings of 20 acres along the Toutle River, were bought out for \$900 thousand by the Federal Emergency Management Agency (FEMA) in September. There is very little sales activity in the areas threatened by flooding. Uncertainty regarding the areas and magnitude of potential flood hazard makes pricing problematical.

The determinants of near-term effects in the real estate market are the weather during the fall and winter and the success of the damage control measures being taken by the Corps of Engineers. In the worst case, severe damage would be sustained in the areas of Castle Rock, Lexington, Kelso, and Longview. Losses would easily exceed those already sustained by several times. In the best case, with favorable weather and control systems functioning as expected, any additional damage will be slight.

G. GOVERNMENT EXPENDITURES

County and Municipal Governments

Many county and municipal governments in this state were financially strained by the Mount St. Helens eruptions while others incurred little or no cost increases due to the eruptions. The degree of financial strain depended upon several factors--proximity to the blast area, depth of ashfall, financial resources, and expertise in intergovernmental cooperation. The majority of cities and counties in this state lie outside the area adjacent to the mountain and outside the areas of ashfall. These counties have not incurred many expenses which can be attributed to the eruptions.

Increases in costs to governmental units within proximity of the mountain or lying in ashfall areas can be placed into three basic categories: (1) emergency services; (2) destruction or damage to property; and (3) ash clean-up. To date, Mount St. Helens related costs to county and municipal governments for these activities have been in excess of \$50 million. The financial burden has been exacerbated for many communities because of inflation and the current recession which threaten tax revenues. Additional reduction of the tax base in Cowlitz County and Skamania County by subsequent flooding would further increase the fiscal difficulties of those counties.

A number of factors have helped to reduce the upward pressure on county and municipal government costs. State and federal emergency services provided limited immediate relief to victims and set up mechanisms for longer term relief. The National Guard was dispatched by the state to

aid in ash clean-up. Cities outside the effected areas, such as Seattle, loaned equipment to impacted municipalities to aid in the clean-up effort. Many individuals volunteered their services to their communities and their neighbors.

Table VI lists, by county and municipality, expenditures attributable to the eruptions. The expenses include costs for emergency services, destruction and damage to property, and clean-up costs. Much of the property damage to municipalities resulted from clogged drainages in storm and sanitary systems. The abrasive nature of the ash also caused damage to machinery and equipment, and water systems.

The cost of the eruptions to county and municipal governments were unevenly distributed geographically. A few counties incurred the brunt of the costs. Cowlitz, Spokane, Yakima, Grant, and Adams Counties were the hardest hit. The distribution ranged from a high of almost \$31 million in Cowlitz County to a low of \$780 in Pend Oreille County. Excluding Cowlitz County, the greatest expenditures were made by port authorities and the larger cities in Eastern Washington.

Another indication of the financial burden is the per capita cost of local government expenditures which is also shown in Table VI. Some counties were more heavily burdened financially even though their total costs were smaller. Cowlitz County was the most heavily impacted county on a per capita basis with estimated costs so far of \$394.79 per resident. Adams County was the next most affected county with per capita costs of \$110.14.

TABLE VI

Expenditures by County and Municipal Governments

<u>County</u>	<u>1980 Pop.</u>	<u>Expenditures</u>	<u>Percentage Total of Expenditures</u>	<u>Per Capita Expenditures</u>
ADAMS	14,000	\$1,542,017	3.1%	\$110.14
County of Adams		\$ 815,900		
Othello		203,961		
Ritzville		498,476		
Washtucna		23,680		
BENTON	105,800	22,079		0.21
Washington Public Power Supply		22,079		
CLARK	186,600	279,650	0.5%	1.50
Vancouver		235,141		
Washougal		1,383		
Yacolt		1,548		
Clark County PUD		41,578		
COWLITZ	78,100	30,843,390	61.3%	\$394.92
County of Cowlitz		27,232,507		
Castle Rock		2,622,870		
Kalama		10,634		
Woodland		3,597		
Longview		519,508		
Kelso PUD		1,782		
Cowlitz County PUD		287,758		
Port of Kalama		150,304		
Cowlitz County Emergency Services		14,430		
FRANKLIN	33,100	7,079	--	0.22
Connell		7,079		
GRANT	49,700	3,224,525	6.8%	\$64.88
Ephrata		126,867		
Quincy		107,226		
Royal City		54,236		
Soap Lake		12,726		
Warden		213,958		

Table VI (cont.)

<u>County</u>	<u>1980 Pop.</u>	<u>Expenditures</u>	<u>Percentage of Total Expenditures</u>	<u>Per Capita Expenditures</u>
GRANT COUNTY (cont.)				
Grant Co. Fire District		9,765		
Port of Moses Lake		500,000		
Quincy Columbia Basin District		79,847		
Grant County Housing Authority		170,900		
Moses Lake		1,949,000		
GRAYS HARBOR	64,600	96,962	0.2%	1.50
Aberdeen		78,566		
Hoquiam		6,655		
McCleary		11,741		
KITTITAS	26,300	248,509	0.5%	9.45
Ellensburg		78,702		
Kittitas		57,306		
Central Wash. Univ.		112,501		
LEWIS	54,300	529,610	1.1%	9.75
Centralia		414,478		
Napavine		32,618		
Toledo		47,842		
Winlock		26,317		
Fire District		3,288		
Lewis Public Transit		1,710		
Fire District		3,357		
LINCOLN	10,400	160,337	0.3%	15.42
Almira		1,719		
Odessa		158,618		
PACIFIC	16,600	15,284	--	.92
PEND OREILLE	8,800	780	--	--
Newport		780	--	--
PIERCE	466,400	22,884	--	--
City of Tacoma		22,884	--	--
SKAMANIA	6,990	42,000	--	6.01

Table VI (cont.)

<u>County</u>	<u>1980 Pop.</u>	<u>Expenditures</u>	<u>Percentage of Total Expenditures</u>	<u>Per Capita Expenditures</u>
SPOKANE	336,600	<u>6,794,769</u>	13.5%	20.18
Spokane		1,956,501		
County of Spokane		4,531,667		
Deer Park		5,065		
Fairfield		8,376		
Spangle		18,972		
Waverly		9,500		
Deaconess Hospital		104,815		
Spokane Int'l. Airport		154,076		
County Fire Protection		5,797		
THURSTON	120,700	<u>33,963</u>	--	0.28
WHITMAN	42,400	<u>3,547,008</u>	7.1%	83.66
Albion		35,998		
Colfax		109,859		
Washington State University		502,785		
Farmington		20,839		
La Crosse		7,521		
Oakesdale		67,211		
Palouse		23,023		
Pullman		77,201		
Tekoa		62,570		
County of Whitman		2,663,024		
Pullman-Moscow				
Regional Airport		18,341		
YAKIMA	164,800	<u>2,884,194</u>	5.7%	17.50
County of Yakima		425,625		
Naches		23,648		
Tieton		12,409		
Toppenish		23,111		
Union Gap		31,288		
Wapato		7,954		
Yakima		2,338,227		
Yakima Housing Authority		2,910		
Yakima County Health		19,022		
TOTAL:		<u>\$50,313,381</u>		

Source: Office of Financial Management, Washington State.

5.4/57-59

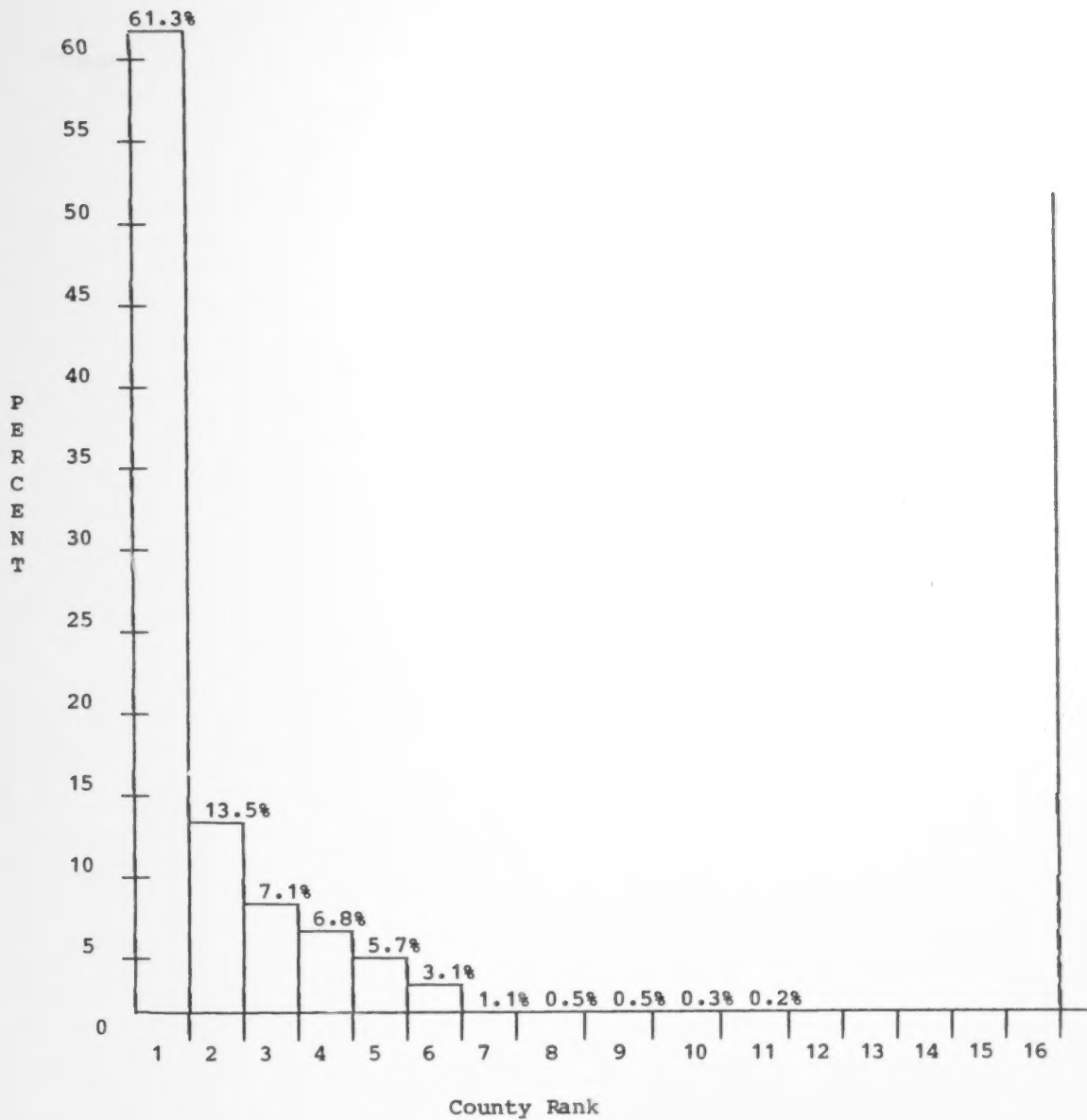
The total impact on county and municipal finances will not be known for some time, since all the damages have not been calculated. Volcano related flooding is expected in Cowlitz County and may continue over a period of several years. All the ash has not been cleaned up, and much of it has not been disposed. The ash is also highly abrasive and this translates into higher maintenance and replacement costs to vehicles, machinery, equipment, and sewer systems.

Following the eruptions, there were indications that some political subdivisions in the state would have difficulties marketing their bonds. An immediate increase in the interest rates necessary to sell bonds in certain areas caused concern in local government within the state. Municipal bonds are very important to local governments because they are the primary method of financing construction and major maintenance projects such as schools, water supplies, public transit, etc. Since bonds for small communities are generally financed within the state, there has been little difficulty in selling these because the local financial community remains confident of the viability of the local communities.

Larger communities which finance through national money markets, however, face some degree of uncertainty. At first, the national financial community indicated an aversion for municipal bonds of Washington communities. This aversion took the form of rejection of certain municipal bonds and a demand for higher interest rates on those found acceptable. The reaction of the national financial community appears to have tempered over time.

Figure I

Distribution of Cost to Local Governments



- | | |
|-------------------|-------------------------|
| 1. Cowlitz County | 9. Kittitas County |
| 2. Spokane County | 10. Lincoln County |
| 3. Whitman County | 11. Grays Harbor County |
| 4. Grant County | 12. Thurston County |
| 5. Yakima County | 13. Pierce County |
| 6. Adams County | 14. Pacific County |
| 7. Lewis County | 15. Franklin County |
| 8. Clark County | 16. Pend Oreille County |

The long term reaction of the national financial community to local government bonds in Washington State is unclear. Some predictions can be made on the basis of reaction to other major events. The negative reaction is likely to dissipate within one to two years. After the financial community has adjusted to the events, a return to normal expectations can be anticipated.

Federal Assistance

Table VII shows the dollar amounts of the disaster relief allocated and processed by federal agencies for the entire state of Washington. The figures understate the total losses because private claims on insurance companies and other institutions are not included. Also, in some sectors a large number of claims are pending. The Small Business Administration has approved \$15 million in loans out of \$430 million in available funds. Small Business Administration business loans were less than \$10 million, over half of which were for ash clean-up. Small Business Administration home loans primarily went to automobile related repair and private home clean-up. Disaster unemployment assistance amounted to slightly over \$491,000 with only four applications pending. Flood insurance amounts to slightly under \$3 million and is for relief in the immediate vicinity of the mountain.

Federal assistance available to the public sector has been slightly greater than federal assistance available to the private sector. The Corps of Engineers accounts for a large portion of the federal assistance available to the public sector. The Corps of Engineers has made available or approved \$215 million. These disbursements are for flood control on the Toutle and Cowlitz River and dredging operations on the Cowlitz and Columbia Rivers.

TABLE VII

Summary of Federal Assistance Funds¹
(\$Thousands)

		Approved ⁴ or Obligated	Disbursed ⁵ or Contracted
<u>PRIVATE SECTOR</u>	<u>Available</u>		
Small Business Admin.	\$430,000	\$ 15,037	\$ 3,259
Emergency Conservation Services	20,000	1,401	1,027
Federal Emergency Management Agency ²		3,712 ²	3,676
Farmers Home Administration ³		1,786 ³	
<u>SUBTOTAL - Private</u>	<u>\$450,000</u>	<u>\$ 21,936</u>	<u>\$ 7,962</u>
<u>PUBLIC SECTOR</u>			
Corps of Engineers	215,000	215,000	137,970
Federal Emergency Management Agency ²	86,000	11,805	8,779
Federal Highway Administration	125,000		
U.S. Forest Service	25,000		
Soil Conservation Service	23,000	11,000	2,148
Office of Education	20,000	8,500	1,000
Department of Interior	7,000		
Department of Health and Human Services	600		
<u>SUBTOTAL PUBLIC</u>	<u>\$501,600</u>	<u>\$246,305</u>	<u>\$149,897</u>
<u>TOTAL</u>	<u>\$951,600</u>	<u>\$268,241⁶</u>	<u>\$157,859⁶</u>

¹Federal Emergency Management Agency Region X Headquarters as of October 13, 1980.

²\$86 million of FEMA funds is from the Presidents Disaster Relief Fund. Flood insurance disbursements are not included in this appropriation. The FEMA funds are not divided into private and public sector disbursements.

³Farmers Home Administration is not included in the \$951 million appropriation. They have made funds available for the Mount St. Helens disaster.

⁴Approved and Obligated funds are a subset of Available funds.

⁵Disbursed and Contracted funds are a subset of Approved and Obligated funds.

⁶Reported totals probably understate actual totals because some approvals and disbursements are not being systematically reported to FEMA.

5.4/60

Some forms of federal assistance were made available to local governments immediately after the May 18 eruption. The Federal Emergency Management Agency (FEMA) set up headquarters in Vancouver, Washington and brought in workers to help local governments. Later, Congress passed a supplemental appropriations bill providing \$951 million to the Pacific Northwest for disaster relief. The appropriation included \$430 million for loans to individuals and businesses to be administered by the Small Business Association; \$215 million for the Corps of Engineers to affected sections of the Columbia River system; \$86 million to FEMA to distribute to local jurisdictions; and \$20 million for allocation to school districts. With the exception of the Corps of Engineers, actual and foreseeable disbursements are expected to be a relatively small portion of this amount; perhaps 35 percent.

One hundred seventy-five local agencies are eligible for the \$86 million FEMA funds. To obtain these funds, local jurisdiction must prepare separate reports for the regional FEMA headquarters and offices in Washington, D.C. Many local agencies did not have the expertise to fill out the federal forms properly to maximize the chances of approval. Part of the problem is that application approval requires three or more months of processing time.

The federal share of eligible costs is 75 percent for those applications that are approved. Of this 75 percent, the federal government withholds 25 percent pending an audit which can take a year or more. Additionally, many of the costs incurred by local governments such as benefits for temporary city employees, supervisory costs, and interest on borrowed interim funds are not eligible items for federal reimbursement. These costs may represent as much as 20 percent of county and municipal expenditures. As a result of

these problems many local governments took a cautious approach to incurring debt to cover costs; neglecting all but the most fundamental clean-up work.

In the meantime, many local governments have already exhausted this year's budget. Steps have been taken to alleviate some of the financial problems. As an example, the state of Washington has instituted a program to assist local governments on a short term basis and major banks in the state have extended generous lines of credit to impacted cities and counties.

H. SELECTED INDUSTRIES¹³

Most of the state's industrial activity is not located in areas where significant ashfall occurred. Very little private industry capital was destroyed in areas that received ashfall from the May 18th and subsequent eruptions. In areas receiving ashfall the event can be analyzed in the same manner as a snowstorm (except that the ash does not melt). Transportation and movement slowed down or came to a halt in areas receiving a significant amount of ashfall. Businesses closed. Deliveries were delayed. Sales and production stopped. Within a few days, however, transportation was restored to normal or near normal levels. As transportation was restored businesses reopened; deliveries, production, and sales resumed. The major costs incurred by businesses were delayed production and sales, and clean-up costs. A few firms experienced increases in maintenance costs due to the abrasive nature of the ash.

As with snowstorms, the costs and inconveniences are correlated with depth. Firms in areas receiving a trace experienced little inconvenience or increase in costs. Firms in the few areas receiving two to three inches of ashfall experienced the greatest inconvenience and cost increases.

The remainder of this section provides a short discussion of the impact of the volcanic eruptions on several major industries in the state. Firms in these industries are located in several areas of the state, only some of which received ashfall. They may exemplify the typical case in that they were not significantly affected.

¹³This section of the report relies heavily upon Northwest Economists Evaluate Volcano's Impact, September 26, 1980.

The transportation manufacturing sector was essentially unaffected. The transportation manufacturing sector includes the Boeing Company which is the largest single employer in the state with approximately 80,000 employees in the Seattle area. The Boeing Company continued to operate at peak capacity in commercial aircraft fabrication at its Seattle-Everett area facilities. However, the flight crew training operations at Moses Lake received heavy deposits of ash and Boeing temporarily moved these operations to Glasgow, Montana. This was to avoid lingering affects of the ash on the aircraft.

Major shipbuilding activities, located primarily in the Puget Sound region, continued operation at pre-eruption levels. A short-term delay in parts delivery was noticed.

Rail and heavy-duty truck production maintained output in regions receiving no ash or light ashfall. Those in the "ash belt" encountered no more than a short-term inconvenience with only minimal increases in costs.

Metals, machinery, and electronic machinery manufacturing make up a significant portion of the industrial output of the state. Concentrated primarily in the Puget Sound region, they produce almost five percent of the total gross output for the state of Washington. However, some major producers are located in counties near the volcano and in areas receiving heavy ashfall.

Metals and machinery manufacturing group was not significantly affected by the volcanic activity (metal and machinery manufacturing includes such industries as aluminum reduction, smelting of ferrous and nonferrous metals, manufacturers of metal products and machinery). Some short-term cost increases were noticed in these industries, primarily

due to trucking raw materials to their plants when ash was on the ground. That was considered a minor irritant. These additional costs are not likely to be noticed at year's end.

Products in the electrical machinery group (transformers, electrical motors and generators, switch gear and electric appliances) have similar characteristics to the non-electrical manufacturing group. No significant or measurable impacts occurred.

The electronic and instrument manufacturing sector is one of the fastest growing industries in the Pacific Northwest. Almost immediately after the eruption a prominent electronics firm announced they were delaying plans to construct a plant in Clark County. Among the reasons given was the uncertainty of operations if there were future eruptions of Mount St. Helens. A survey of other electronic firms located in the Pacific Northwest indicate the industry in general is not very concerned about the volcanic eruptions. These firms plan to continue expansion in the Pacific Northwest. The survey determined that the firms had experienced no significant loss as a result of past eruptions, and they appear to have developed processes to cope successfully with the ashfall. Most businesses reported shutdowns from three hours to two days, about the equivalent of a winter snowstorm.

5.4/1-55

TABLE VII
 Revised
 Summary of Federal Assistance Funds¹
 (\$Thousands)

<u>PRIVATE SECTOR</u>	<u>Appropriate</u>	<u>Approved⁴ or Obligated</u>	<u>Disbursed⁵ or Contracted</u>
Small Business Admin.	\$430,000	\$ 68,000	\$ 27,500
Emergency Conservation Services	20,000	2,600	1,870
Federal Emergency Management Agency ²		6,185 ⁷	5,736 ⁷
Farmers Home Administration ³		1,786 ³	
<u>SUBTOTAL - Private</u>	<u>\$450,000</u>	<u>\$ 78,571</u>	<u>\$ 35,106</u>
<u>PUBLIC SECTOR</u>			
Corps of Engineers ⁸	215,000	215,000	215,000
Federal Emergency Management Agency ²	86,000	25,119	16,076
Federal Highway Administration	125,000	13,000	-0-
U.S. Forest Service	25,000	11,600	
Soil Conservation Service	23,000	7,000	2,148
Office of Education	20,000	1,100	1,100
Department of Interior	7,000		
Department of Health and Human Services	600		
<u>SUBTOTAL PUBLIC</u>	<u>\$501,600</u>	<u>\$272,819</u>	<u>\$234,324</u>
<u>TOTAL</u>	<u>\$951,600</u>	<u>\$351,390⁶</u>	<u>\$269,430⁶</u>

¹Federal Emergency Management Agency Region X Headquarters as of March 5, 1981.

²\$86 million of FEMA funds is from the Presidents Disaster Relief Fund. Flood insurance disbursements are not included in this appropriation. The FEMA funds are not divided into private and public sector disbursements.

³Farmers Home Administration is not included in the \$951 million appropriation. They have made funds available for the Mount St. Helens disaster.

⁴Approved and Obligated funds are a subset of Available funds.

⁵Disbursed and Contracted funds are a subset of Approved and Obligated funds.

⁶Reported totals probably understate actual totals because some approvals and disbursements are not being systematically reported to FEMA.

⁷This figure includes \$4.66 million in flood insurance programs not funded by special Mount St. Helens appropriation.

⁸The Corps of Engineers estimates that full recovery of the Cowlitz-Tootle flood control system will require an additional \$700 million effort over five years.